Approved 12/17/04 MR

Amendments in the specification

1) Please replace the paragraph beginning on line 19 of page 1 with the following paragraph:

Electromechanical devices can be integrated in electronic circuits. The prior art describes a large number of such devices that are used as tools by ~~the~~ electrical engineers to build various types of electronic circuits such as, for instance, RF circuits and RF electronics. These devices can be tailored for different types of applications each with its own specifications. In ~~the~~ prior art~~,~~ electromechanical devices, such as piezoelectric devices, piezoelectricity sets in motion solid plates in response to an electrical signal. The mechanical displacement is coupled to another piezoelectric, or the same piezoelectric is coupled with another electrode, to make mechanical devices and filters. The electromechanical devices would have one input and one or more outputs. The device thus made can be a transformer or a filter with different characteristics. The electromechanical devices could also be magnetic devices, instead of piezoelectric devices, wherein a magnetic field sets in motion the solid plates in response to an electrical signal. The present invention provides a new class of electromechanical devices based on micro-machining techniques that competes with their piezoelectric or magnetic equivalents.

2) Please replace the paragraph beginning on line 12 of page 2 with the following paragraph:

The present invention provides an apparatus and method for a new class of micro-machined electromechanical devices that make use of resonant membranes. The electromechanical device of the present invention includes two or more electrodes which are positioned with a membrane. A gap exists between the membrane and each electrode which may vary for each electrode. In general, one electrode is used as an input electrode which receives an electrical signal that causes vibration of the membrane. The vibration of the membrane is then coupled to a receiving or an output electrode. The present invention also includes one or more output electrodes. The membrane is a vibrating coupling membrane which is preferably made out of, but not limited to, ~~preferably made out of~~ silicon nitride. A DC bias voltage is applied to the electrodes to set or modify a width of a gap in the electromechanical device. The electromechanical device of the present invention could be designed as a transformer, a capacitor, a resonator or a filter. In addition, the present invention includes a control voltage to dynamically change the coupling between the input electrode and the output electrode(s). In exemplary embodiments, the present invention is shown with two electrodes of rectangular shapes either side by side or opposite from each other. The present invention is not limited to the number of electrodes, shape of electrodes, or position of the electrodes with respect to the membrane. In addition, the membrane could have different sizes and shapes depending on the application. The present invention also includes an apparatus and method for an electronic system that integrates an electronic circuit, having one or more standard electronic components, with one or more membrane coupled micro-machined electromechanical devices.

3) Please replace the paragraph beginning on line 22 of page 3 with the following paragraph:

~~The~~ An advantage of the present invention over the prior art is that the present invention enables one skilled in the art to make a new class of micro-machined electromechanical devices that are based on membrane coupling and integrate these devices in electronics making electronic circuits.

4) Please replace the paragraph beginning on line 16 of page 4 with the following paragraph:

The present invention provides a new class of electromechanical devices that make use of resonant thin membranes. More specifically, the present invention uses a set of membrane-coupled capacitors as, for instance, but not limited to, a transformer, resonator and a filter. In a coupled capacitor device of the present invention, a membrane positioned between two electrodes constitutes two coupled capacitors in series. In general, two or more electrodes could be used and coupled to the membrane. A gap exists between each electrode and the membrane. Gaps can have different sizes and are usually in the order of μm. The electrodes are made out of any type of conductive material, such as, but not limited to, a metal material. Most of the time, one electrode is used as the input, while the other electrode serves as the output. The present invention also includes having multiple electrodes as output. A DC bias

voltage applied to each electrode is used to set or modify the width of the gap in each capacitor, which in turn determines the position of the membrane. When set into motion, the membrane couples the output, or outputs, to the input, hence the coupled capacitors ~~acting~~ act as a transformer. The ratio of the AC output to the input voltages, which is a measure of the transformation ratio of the transformer, is proportional to the DC bias voltages, the widths of the gaps, and the areas of the capacitors. Since this ratio can be controlled by the application of the DC bias voltages, the transformer can be made to be adaptable to the variations in the impedances of the load and the source it couples, which are to be matched.

5) Please replace the paragraph beginning on line 18 of page 5 with the following paragraph:

In an exemplary embodiment of the present invention, two capacitors **100** and **102** are made side-by-side on a substrate **104** as shown in **FIG. 1**. **FIG. 1** shows an exemplary transformer configuration **10** using two back to back micro-machined capacitors that share a single vibrating coupling membrane **106**. The gaps **108** and **110** of the capacitors **100** and **102** can be set by the micro-machining or other manufacturing process, and the areas of the metal electrodes **112** and **114** in the capacitors can also be varied. The location of the output electrode **112** can be chosen based upon the nature of an application, and there can be more than one output electrode. The vibrating coupling membrane **106** itself can be made of any material such as silicon carbide, diamond, silicon, glass and the like, though silicon nitride is

a preferred choice. Also the vibrating coupling membrane can be mechanically connected to the substrate in different ways to adjust ~~it~~ its resonant mode shapes and to minimize the energy losses to the substrate structure. Also to eliminate losses to the surrounding medium, the electromechanical device can be placed in a vacuum-sealed cavity. When operating at or below the lowest order resonance, membrane **106** couples output **114** to input **112** in the same fashion as described above. At higher frequencies, membrane **106** can be resonant at some modes in which the displacements of metal electrodes **112** and **114** are out of phase with each other, thus altering the input to output relationships of the transformer. The shape of the capacitors can be of any geometry, and the metal electrodes (one input and one or more outputs) can be of varying shapes (circular, square, rectangular or combinations of the like) to take the advantage of certain resonance modes of membrane **106** in a particular application. Hence, the corresponding transformer is made to operate at certain frequencies with predictable gain.

6) Please replace the paragraph beginning on line 22 of page 7 with the following paragraph:

FIG. 2 shows another configuration **20** of a set of coupled capacitors **200** and **202** that can be used as a transformer or filter. Here, the two capacitors **200** and **202** are made side by side on the same substrate ~~**200**~~ **201**. The gaps **204** and **206** of the capacitors **200** and **202** can be made different via the micro-machining or any other type of manufacturing process. The metal electrodes **208** and **210** of each capacitor can also be made of

different sizes or areas. The location of the second electrode can be chosen based on the application, and certainly more than one output metal electrode can be made. Membrane **212** itself can be made of any number of materials though the material of choice is silicon nitride. As shown in **FIG. 2**, one electrode is used as an input while the other is used for an output. The present invention is not limited to the number or shape of electrodes. For instance, multiple output electrodes can be used. The DC bias applied to each is used to set the gap height. There is coupling between the two DC biases, and one should control the values of both DC biases in order to obtain the desired gap heights. When operating at or below the lowest order resonance, membrane **212** is set into motion and the output is coupled to the input in the same fashion as explained earlier with respect to **FIG. 1**. At higher frequencies, membrane **212** can be resonant around some modes where the displacements at each metal electrode are out of phase with respect to each other thus altering the input to output relationships of the transformer.

7) Please replace the paragraph beginning on line 1 of page 9 with the following paragraph:

The family of devices proposed here can be integrated with electronics, thus making part of the electronic circuit. In short, the family of devices proposed increase the family of electronic devices available to circuit designers of RF circuits and RF electronics. ~~Not to forget is that~~ Furthermore, the character of these devices can be changed by the application of DC bias. Thus, the transformer ratio or the filter response can

be altered to fit variation in a circuit, such as due to aging, and force the response of the circuit to be stable and the same over long periods of time.